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PRELIMINARY REPORT ON THE PUMP PACKING TRIAL AT LINGAN COLLIERY

P. Cain
Cape Breton Coal Research Laboratory

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PRELIMINARY REPORT ON THE PUMP PACKING TRIAL AT LINGAN COLLIERY

by

P. Cain*

ABSTRACT

This is an interim report on the trial of monolithic pump packing on the 9E Coal Road at Lingan Colliery. Details of the packing system are given, along with a description of some of the initial problems and steps taken to overcome them.

*Research Scientist, Strata Control, Cape Breton Coal Research Laboratory, CRL, CANMET, Energy, Mines and Resources Canada, Sydney.

RAPPORT PRÉLIMINAIRE SUR LES ESSAIS DE REMBLAI À LA MINE LINGAN

par

P. Cain*

RÉSUMÉ

Ce rapport intérimaire a pour objet les essais de remblai monolithique dans la galerie 9E de la mine Lingan. Les détails du système de remblai monolithique y sont aussi présentés, suivis d'une brève description de quelqu'uns des problèmes rencontrés au début des travaux et des solutions qu'on y a apportées.

*Chercheur scientifique, Contrôle des strates, Laboratoire de recherche sur le charbon du Cap-Breton, LRC, CANMET, Énergie, Mines et Ressources du Canada, Sydney.

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INTRODUCTION

Very high levels of air leakage through the longwall wastes threatened to disrupt production on the east side of Lingan Colliery where two adjacent longwalls were operating. Details of gob leakage are given elsewhere (1,2).

In order to alleviate the leakage problem, the Cape Breton Development Corporation (CBDC) opted to install a monolithic pump packing system in the 9E Coal Road (Figure 1) to improve gob sealing and reduce leakage. This measure was recommended but not addressed in a review of gateroad sealant technologies commissioned by CANMET, Cape Breton Coal Research Laboratory (CBCRL) in 1984 (3). Some experience with monolithic packing existed within CBDC as a result of a trial of an 'Aquapack' pump packing system on the 3W Coal Road in the spring of 1982. In this instance the pack width was only 1 m and the result was more in line with a gateroad sealant than a fully supportive pumped pack.

To economise for the trial period, CBDC chose to use the 'Aquapack' placement equipment which was refitted in the colliery workshops. Since the 1982 trial, developments in pumped pack cement technology had resulted in the commercial availability of two similar products which required 20% less material than the 'Aquapack' system. Both products are manufactured in the United Kingdom; 'Tekpack' by Foseco has been used there with some success for 18 months. 'Astrapack' by Pozzament Cements Limited is a relatively new competing product. Both products comprise two components, a high alumina cement blend ('Tekcem' and 'Astracem' respectively) and a bentonite/accelerator blend ('Tekbent' and 'Astrabent' respectively) which are mixed separately and pumped to the packhole prior to entering a bag which holds the mix until it sets. Mix ratios required for these three systems are given in Table 1. 'Astrapack' was chosen for the 9E trial over 'Tekpack' as the result of a competitive bidding process.

UNDERGROUND INSTALLATION

The underground installation of the pump packing system employs two mixing/pumping stations for the 'Astrabent' and 'Astracem' slurries.

Table 1 - Mix ratios for 'Aquapack', 'Tekpack' and 'Astrapack' (quantities per m^3 of pack)

	'-cem' kg	'-bent' kg	water kg
Aquapack	450	50	915
Tekpack	182	182	910
Astrapack	175	175	876

The 'Astrabent' mixing/pumping station is located at the junction between the 9E Coal Road and No. 4 Deep (Figure 2). A colcrete type 5D continuous colloidal mixer is connected to an Evans MK 64 piston pump. Both are powered from the same electrohydraulic power-pack comprising a 55 kW (75 hp) electric motor coupled by a Reynolds chain to a colcrete hydraulic pump delivering 64 L/min (14 Imp gal/min) to the pump and 45 L/min (10 Imp gal/min) to the mixer. The hydraulic pump is cooled using water from the mine main which is reduced from 3.44 MPa (500 psi) to 1.4 MPa (200 psi) at a pressure reducer prior to use. 'Astrabent' is fed into the mixer at the rate of 25 kg/min (55 lb/min) from an integral hopper via a vertical screw feeder powered by the hydraulic pump. The colloidal mixer is set at 1000 rpm with a water feed of 64 L/min (14 Imp gal/min). Feed rates, mixer speeds and pump output are regulated and calibrated by controls on the mixing/pumping stations. Station dimensions are given in Table 2.

Table 2 - Dimensions of mixing/pumping station components

Component	length (mm)	width (mm)	height (mm)
Power-pack	2700	1000	1000
Mixer	1650	920	1180
Pump	3250	715	900

The mixed 'Astracem' slurry is pumped to within 100 m (300 ft) of the face in 2.5 cm (1 inch) diameter water pipe at which point flexible hose is used to carry the slurry to the mixing/delivery nozzle at the packhole.

The 'Astracem' station straddles the floor mounted stageloader approximately 30 m (100 ft) from the coalface. The mechanical details, feed rates and flow rates are exactly the same as those of the 'Astrabent' station except that 'Astracem' is the material used to make the grout. The 'Astracem' is then pumped in 2.5 cm (1 inch) diameter flexible hose to the mixing/delivery nozzle at the packhole where it splash-mixes with the 'Astrabent' slurry prior to entering the packing bags.

The packing bags are manufactured in Sydney, Nova Scotia from Novathene GMB 2, a plasticised flame retardant anti-static material approved for pump packing use by Labour Canada. The material was developed jointly by Polymer International of Truro, N.S. and Premium Distributors, Sydney, N.S. and the bags are made and marketed by Premium Distributors. The bags are 2.4 m (8 ft) high, 2.1 m (7 ft) wide and 1.2 m (4 ft) long, and are fitted with ties to allow correct hanging in the packhole. The packs are installed in 1.2 m increments. The selection of 2.1 m (7 ft) as the pack width has been described in a previous report (4).

In addition to the mechanical elements of the packing system, each pumping station and the packhole has a dedicated communications system to allow control of the pump process.

The pack shutter was made to an NCB (U.K.) design by CBDC. It is a hinged two-piece steel cage with vertically oriented shooting bolts at intervals around the top to allow the packing bag to be raised to the roof. The shutter is supported by four Dowty hydraulic props when the bag is being filled.

PACKING PROCEDURE

The initial stages of the pump packing trial were assisted by personnel from Pozzament Cement Limited and Colcrete Ltd. of the U.K., suppliers of the packing material and pumping machinery respectively.

The first stage of the packing procedure is the erection of the shuttering and hanging of the bag, taking care to ensure that no folds can

develop in the bag and that no sharp objects in the packhole can burst it. The 'Astrabent' pump is then activated, delivering 64 L/min (14 Imp gal/min) or 'Astrabent' slurry. When the whitish slurry is observed at the mixing nozzle the 'Astrabent' pump is stopped and the same procedure followed with the 'Astracem' pump. When the dark brown 'Astracem' slurry is seen at the mixing nozzle the 'Astracem' pump is stopped, the mixing nozzle is placed in the packing bag and both pumps are restarted and run until the bag is full. A non-return flap on the packing bag assists sealing when the nozzle is removed upon the completion of the pack.

The specified strength of the 'Astracem' pump packing material after one hour (0.5 MN/m^2, 72 psi) allows the removal of the shutter at that time. The cement pump and line is flushed out after each pack is placed to prevent remnant cement grout from setting in the delivery line. When the pack has set, the shuttering is removed and advanced and the packing cycle begins again.

The support regulations for the face end of 9E Coal Road are shown in Figure 3.

PROBLEMS

The usual problem experienced in trials of monolithic pump packing is the maintenance of correct mix ratios by inexperienced operators. In this particular type of pack - where the water:solids ratio is high - it is important to maintain correct mix ratios for two reasons. Firstly, too low a solids content impairs early pack strength and increases the length of the packing cycle; in addition, the low long term strengths obtained are detrimental to good strata control. Secondly, the specially blended cements are usually expensive and too rich a mix increases the packing costs unnecessarily.

As expected, early problems were experienced in the maintenance of correct mix ratios, although this has been attributed to inadequate calibration of the pumps and hopper screw feed, and mechanical breakdowns during packing. In some packs 50% oversupply of materials has been recorded, leading to unnecessary expense.

Correct hanging of the packing bags has also caused some problems along with placing of the shutter. If the bags are hung so that folds can develop during packing, tearing is inevitable before the packhole is filled. If the shutter is not positioned correctly, it does not support the bag and the bag will burst.

A more serious problem has been the tendancy of packs not to set properly. To investigate this phenomenon, CBDC initiated an on-site monitoring programme, recording details of the pumping cycle for each pack. Concurrently, CBCRL were asked to investigate the strength development of the packing material. It was during this series of tests (5) that the sensitivity of the mixture to low water and ambient temperatures (16°C, 60°F) was identified and determined. Steps are currently being taken by CBDC to install a water heater at the 'Astrabent' station to preheat the water prior to use and ensure a mixed slurry temperature of around 25°C in the packing bag.

STRATA CONTROL

Investigations of gateroad deformation and pack loading are currently underway. Qualitative visual observations indicate no deterioration in roadway conditions, but to maintain an adequate roadway profile for ventilation and transport, three items should be addressed.

Firstly, the current practice of setting four struts on each arch is inadequate. Eight struts per arch is a preferable standard and would assist the reduction of arch deformation.

Secondly, lagging of either mesh, corrugated steel or timber should be placed in the arch web on the pack side to offer some confinement to the pack as it bulges into the roadway under load. This will increase the load bearing capacity of the pack and prevent pack material from spilling into the roadway. Where possible this lagging should be backfilled to offer even earlier confinement to the pack.

Thirdly, up to 0.75 m (2.5 ft) of gateroad height is being lost as the rail track is laid and ballasted. This is especially apparent in local swilleys where the track bridges the depression in the roadway floor. Consideration should be given to the use of low profile metal sleepers, bolted or dowelled into the floor for stability. This would result in an

approximate 10% increase in gateroad cross-sectional area, reducing air resistance and therefore gob leakage.

CONCLUSIONS

The 'Astrapack' trial has been underway on the 9E Coal Road for six weeks. Most of the early problems have been identified and are now in the process of being corrected. The two most pressing problems were inconsistent mix ratios due to operator inexperience and poor calibration of the mixing station, and the poor setting characteristics of the material under the low ambient temperatures.

The problem of maintaining correct mix ratios will be alleviated by the purchase of batch-mixing tanks to replace the colloidal mixers. The water temperature problem will be corrected by the inclusion of a water heater at the 'Astrabent' station to ensure a mix temperature of at least 20°C (77°F) in the packing bag.

Quantitative assessments of strata control and gob leakage performance have not yet been made. Qualitative assessment of gateroad deformation seems to indicate that no deterioration in gateroad conditions is taking place. Further improvements in gateroad condition could be achieved by correct strutting of the arches, lagging the high side arch leg to contain the pack and modification of track laying practise to reduce the amount of ballast used.

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REFERENCES

1. Cain, P. et al. "Preliminary report on studies into gob leakage in the Sydney Coalfield"; Department of Energy, Mines and Resources Canada, CANMET, Division Report ERP/CRL 84-43(OP); presented at 4th AGM CIM District 1, St. John's Newfoundland; November 2, 1984.
2. Stokes, A.W. "Preliminary ventilation survey for 9 East longwall prior to implementation of monolithic packing"; Department of Energy, Mines and Resources Canada, CANMET, Division Report ERP/CRL 85-24(TR).
3. "A detailed review of gateroad sealants to reduce gob leakage in advancing longwall sections in the Sydney Coalfield"; Final Report by Associated Mining Consultants Limited on Department of Supply and Services, Canada; Contract Serial Number OSQ83-00222.
4. Cain, P. "Determination of required pack width for a monolithic pack installation in the 9E Coal Road, Lingan Colliery"; Department of Energy, Mines and Resources Canada, CANMET, Division Report ERP/CRL 85-35(TR).
5. Cain, P. "Initial strength development in 'Astrapack' pump packing material"; Department of Energy, Mines and Resources Canada, CANMET, Division Report ERP/CRL (in preparation).

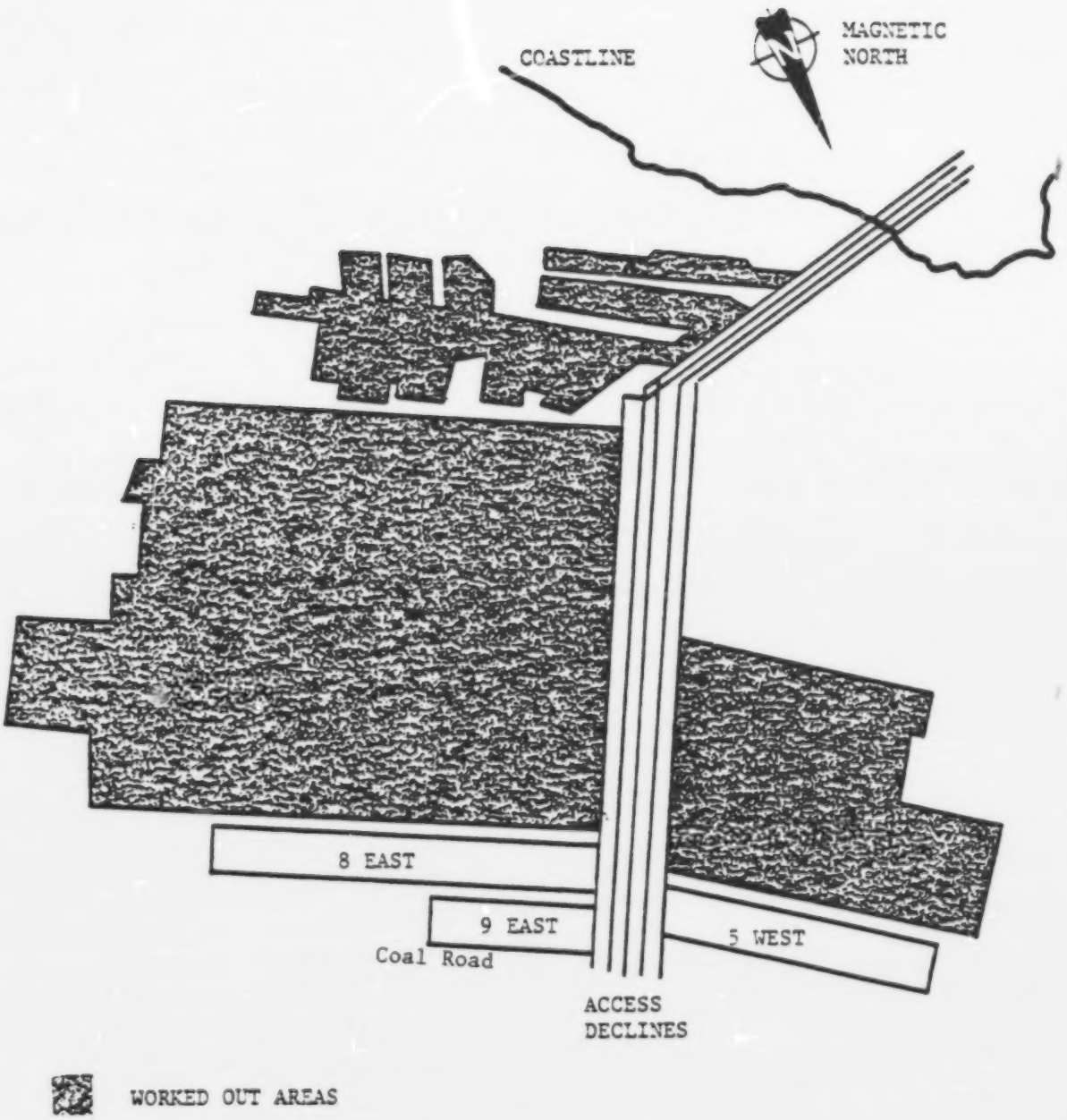

Figure 1 - Location of 9E Coal Road at Lingan Colliery

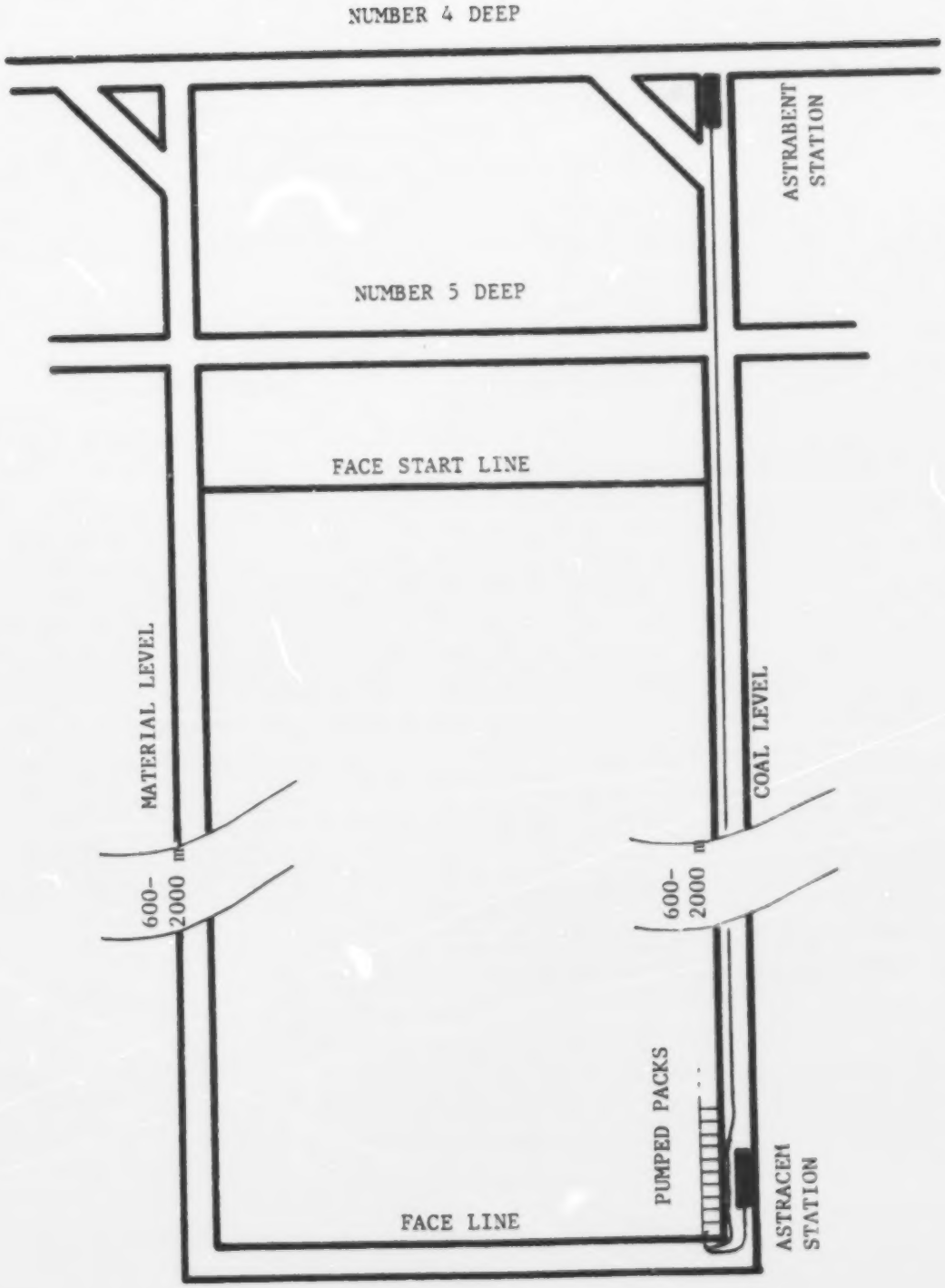

Figure 2 - Schematic of pump packing equipment in 9E Coal Road, Lingan Colliery

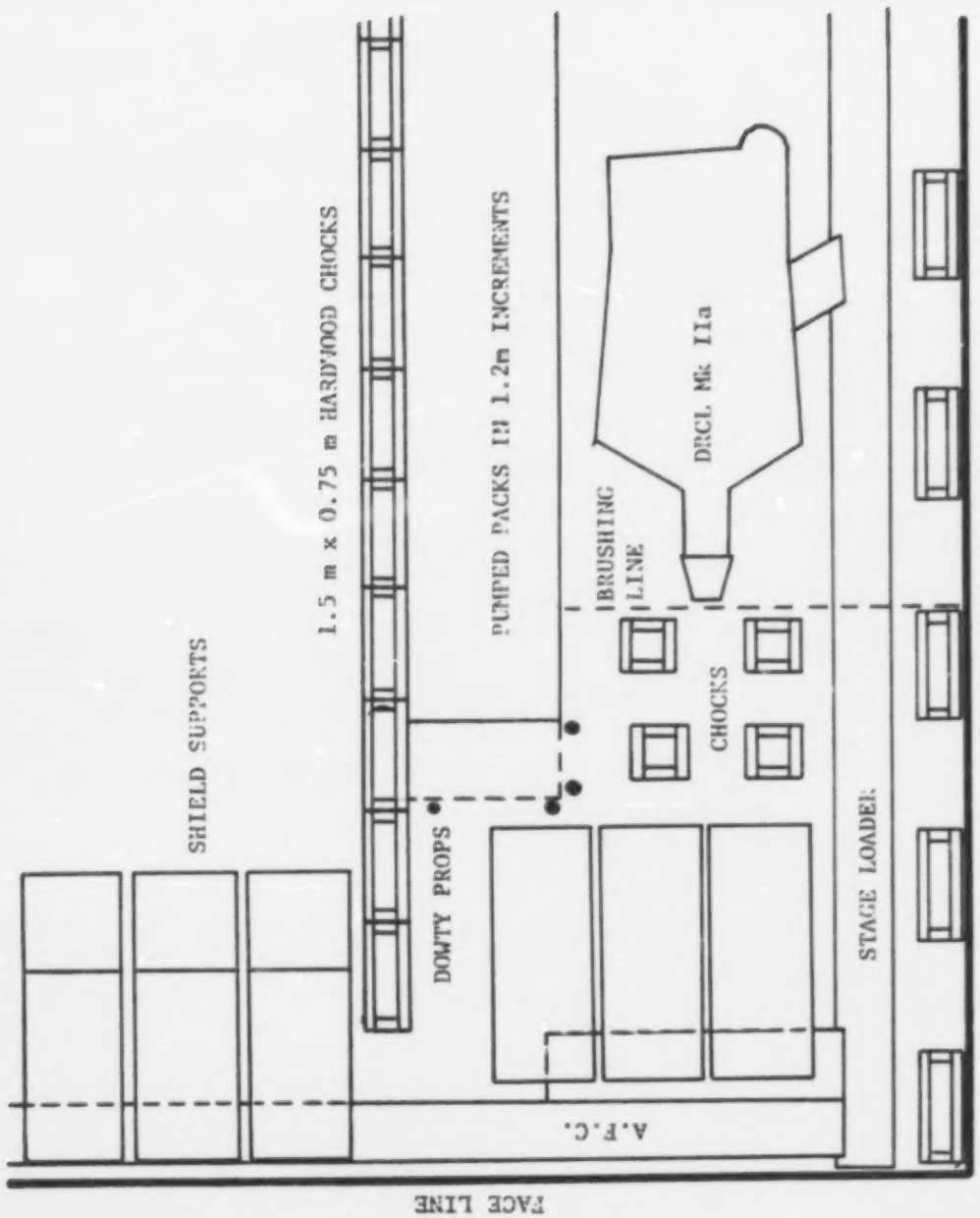

Figure 3 - Support regulations for 9E Coal Road at the face end